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# Assessing Public Healthcare Infrastructure in the Kamand Region

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# **Assessing Public Healthcare Infrastructure in the Kamand Region**

An Interactive Qualifying Project  
submitted to the Faculty of  
WORCESTER POLYTECHNIC INSTITUTE  
in partial fulfilment of the requirements for the  
degree of Bachelor of Science

by  
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Date:  
29th April 2015

Report Submitted to:

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and  
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Worcester Polytechnic Institute

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# Assessing Public Healthcare Infrastructure in the Kamand Region



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# Abstract

In the Kamand region of Himachal Pradesh, the healthcare challenges of rural communities are unique due to difficult terrain, distance between health-centres, and disease patterns. This project assessed the public healthcare infrastructure's ability, in terms of quantity and quality, to cope with these challenges. Our assessment revealed three bottlenecks in service delivery: inadequate supplies, lack of specialists, and inaccessibility of facilities. Based on our analysis, we recommended changes to the system that might improve public access to quality medical care.

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# Authorship Page

**Prateek Gauba** contributed to the translation and analysis of the interviews conducted and the recommendations section.

**Philippe Kelley** contributed to the writing and editing of each section of the report; the development of RHAM; the mapping of the regional healthcare infrastructure; the analysis of the statistics from Zonal Hospital Mandi; the photographs of our observations; the development of documentation tools; and the design of the poster.

**Divakar Maurya** contributed to the translation and analysis of the interviews conducted; the mapping of the regional healthcare infrastructure; and the design of the poster.

**Nathaniel Porter** contributed to the writing of each section of the report; the development of RHAM; the analysis of the statistics from Zonal Hospital Mandi; the photographs of our observations; the design of the executive summary booklet; and the design of the poster.

**Johanna Santos** contributed to the writing and editing of each section of the report; the development of RHAM; the development of documentation tools; the analysis of the statistics from Zonal Hospital Mandi; the photographs of our observations; the SWOT analyses of our recommendations; and the design of the poster.

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# Executive Summary

## Challenges to Public Healthcare in the Kamand Region

Access to quality public healthcare remains a pressing need amongst rural and remote populations of India. While the government has introduced successful initiatives (e.g., for malaria and tuberculosis) at the state and district levels (Ministry of Health & Family Welfare Government of India, 2005), lack of resources and other constraints limit healthcare efforts from reaching remote areas. The healthcare needs of urban populations and those of rural areas differ significantly, in part due to

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*Health is an intrinsic human right as well as a central input to poverty reduction and socioeconomic development (World Health Organization, 2015).*

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distance between health centres and villages, poor infrastructure and water quality, and site-specific disease patterns.

Our research focused on Mandi in Himachal Pradesh. In this mountainous region (Figure 1), difficult terrain and ongoing road construction impair transportation and lead to infrequent deliveries of medicine. Another challenge includes insufficient treatment capacity, including a paucity of trained professionals in rural areas and operating hours in clinics.

The goal of this project was to assess the public healthcare infrastructure in the Kamand region, specifically, the Zonal Hospital Mandi (Figure 2) and the health centres and sub-centres in the medical block of Kataula. We identified bottlenecks so resources might be allocated to improve health system functionality. In order to achieve our goal, we developed a “Rural Healthcare Assessment Model” to assess



*Figure 1. The challenging terrain of Mandi.*



*Figure 2. Zonal Hospital Mandi.*

the infrastructure across the dimensions of location, facilities, services, and stakeholder perceptions of quality. Our objectives for performing this assessment were to document geographical locations, the facilities’ physical resources and operation, and medical services. We also evaluated provider and user perceptions of service quality. These data allowed us to locate high-pressure areas, or bottlenecks, in service delivery. Our research led to recommendations that we delivered to the Chief Medical Officer of the Mandi District.

# Healthcare Facilities, Personnel, and Common Health Risks in the Kamand Region

In preparation for our fieldwork, we researched the existing healthcare system in Mandi, prevalent disease patterns, and criteria for assessing healthcare systems.

## Regional Medical Capacity

Mandi City, located in the center of Himachal Pradesh, is home to Zonal Hospital Mandi, which serves four medical “blocks,” each comprising sub-centres, primary health centres, and community health centres, as defined in Table 1.

*Table 1. Definition of CHC, PHC, and SC in India (adapted from SRM University, n.d.).*

Facility	Serviced Population	Responsibilities
<b>Sub-Centre (SC)</b>	3,000 – 5,000	<ul style="list-style-type: none"><li>• Documenting number of regional pregnancies</li><li>• Coordination of health programs</li><li>• Triage</li></ul>
<b>Primary Health Centre (PHC)</b>	20,000 – 30,000	<ul style="list-style-type: none"><li>• Health and nutrition education</li><li>• Promoting safe water and personal hygiene</li><li>• Antenatal and postnatal care</li><li>• Immunizations</li><li>• Disease and injury treatment</li><li>• Triage</li><li>• Training</li></ul>
<b>Community Health Centre (CHC)</b>	80,000 – 120,000	<ul style="list-style-type: none"><li>• All of the above</li><li>• Surgery</li><li>• Medicine distribution</li><li>• Gynecology</li><li>• Pediatrics</li><li>• X-ray</li></ul>

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*The weather and fertile soil of Himachal Pradesh is conducive to the growth of medicinal plants that have been used to treat ulcers, acidity, sores, inflammation, dyspnea, fever, stomach ache, head ache, arthritis, wounds, and allergies, among other symptoms associated with local seasonal and communicable diseases (Kuar, Shalini, & Sukhbir 2011).*

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In order to manage the large population of Himachal Pradesh, public services are augmented by several medical practitioners who receive only minimal training. They serve local villages and often rely on plant-based and traditional healing. They and their roles are described in Table 2.

Table 2. Local practitioners at the village level (adapted from SRM University, n.d).

Occupation	Description	Training
<b>Village Guide</b>	The first contact between a patient and the health system. The village guide treats simple medical problems, administers first aid, provides maternal care and child care including family planning, and is responsible for sanitation and health education.	Minimal formal education and 3 months training in the nearest PHC.
<b>Anganwadi Workers</b>	Performs routine check-ups and immunizations. The worker also provides supplementary nutrition, health education, and referral services.	4 months in numerous aspects of health, nutrition, and child development.
<b>Local Dais</b>	Female birth attendants that have obstetric skills and promote sterilized births in the home.	30 days at the nearest PHC or SC. Training involves spending 2 days at the PHC and 4 days accompanying a health worker a week.
<b>Lay Practitioners</b>	Traditional or religious healers that use medicinal plants for treatments.	No formal training.

### Environmental Factors and Disease

*In the 2013 monsoon season, one of the worst on record, 20 cloudbursts caused flash floods that resulted in two deaths in Mandi and many more around Himachal Pradesh (“20 Incidents of Cloudbursts”, 2013).*

The Kataula Medical Block, which services Kamand, is accessible by a network of narrow dirt roads. Emergency evacuations and basic transportation to health centres may be challenged by road conditions, weather events, flooding, landslides, and earthquakes. Kamand’s susceptibility to natural disasters exacerbates these problems.

Seasonal weather also can influence the patterns of regional disease. According to a doctor at the Ratti CHC, during monsoon season, cases of gastroenteritis, diarrhea, and typhoid rise; in winter, cases of respiratory ailments such as influenza and tuberculosis increase. Table 3 displays the statistics for these diseases in 2014. In rural areas specifically, the severity of respiratory ailments and gastrointestinal disease is exacerbated due to poor sanitation, anemia, and malnourishment (“Himachal Pradesh”, n.d.; Ashokvardhan, 2002). Other common ailments include diabetes and cardiovascular disease (Himachal Pradesh, n.d). The Indian Department of Medicine predicts that by 2025, 70 million Indians will be diagnosed with diabetes, which also accounts for many cases of reported blindness (Raina, 2012). As of 2011, cardiovascular diseases were contributing to

Table 3. 2014 disease statistics of the Ratti and Kataula CHCs.

Institution	Dysentery /Diarrhea	Typhoid	Anemia	Worm Festation	TB	Eye Diseases	Otitis Media	Injury	Pneumonia	Respiratory Diseases	Other Ailments	Total Patients
ZH Mandi	2332	133	1465	1649	158	20396	10392	8368	944	22652	337838	406327
CHC Ratti	1204	19	3650	3247	60	615	129	432	4	5398	52951	67709
CHC Kataula	348	10	140	197	11	219	109	480	27	2148	16504	20193

roughly 40 million deaths annually in India (Yudkin et al., 2012). In rural areas, cases of hypertension have increased exponentially due to poor diet and increased physical and mental stress from agricultural and labor-intensive work (Yudkin et al., 2012).

In addition to the risks detailed above, residents in remote and rural areas have higher

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*A trauma-related death occurs in India every 1.9 minutes (Joshipura et al., 2004).*

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risk of trauma injuries. Since there are no governmental regulations in India that establish standards for trauma-care, only elementary systems exist and are located in urban areas (Joshipura, Shah, Patel, & Divatia, 2004). Thus, road-side or work-related injuries, lacerations, fractures, and other accidents common in Himachal Pradesh put its

rural population at a greater risk for trauma-related death, especially where response is delayed (Joshipura et al., 2004).

### **Rural Healthcare Delivery**

In rural areas with difficult terrain and long distances between villages and health centres, more residents will get healthcare if it is easily accessible. This was shown when mobile medicine options such as The Lifeline Express train in another rural Indian setting reached patients in remote areas and when government sponsored hospital trucks in Zambia reached huge numbers of patients (Singh, 2010 & Williams, 2011). In addition to providing better access, rural areas can improve healthcare delivery through better communication between doctors and healthcare professionals. For example, in a case study in rural Peru, where a few small clinics had to serve a very large population, unimpeded communication between healthcare workers was instrumental in ensuring that each patient got the correct care for their ailment (Martinez et al. 2004). Having a network in place in which doctors can consult with one another and make referrals can ensure that the correct treatment is administered and resources are conserved.

### **Healthcare Standards and Assessment**

Standards exist in healthcare to ensure that the “highest possible percentage of the

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*Primary healthcare...will include at least: promotion of proper nutrition and an adequate supply of safe water, basic sanitation; maternal and child care, including family planning; immunization against the major infectious diseases; education concerning basic health problems and the methods of preventing and controlling them; and appropriate treatment of common diseases and injuries (World Health Organization, as cited in Walshe, 2011, p. 169).*

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best medical knowledge and skill available in a community reaches the patients in the [healthcare facilities] of that community” (Timmermans & Berg, 2010). The World Health Organization recommends that primary healthcare facilities should include preventative, curative, and rehabilitative services. However, factors such as poor accessibility, limited resources, and hindered communication may prevent the medical knowledge and skill from reaching all the facilities in rural or remote areas. There is a commonly used tool in service quality assessment called SERVQUAL/RATER. This tool measures reliability, assurance, tangibles, empathy, and responsiveness in the context of any service industry.

This rubric can reveal inadequacies or gaps in management and communication, as well as whether or not there is a mismatch between consumer expectations and the actual service received (Shahin, 2006). For the purposes of



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*Healthcare quality can be defined in relationship to the technical aspects of care, the interpersonal relationship between practitioner and patient, and the amenities of care (Andaleeb, 2001).*

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our project, we combined criteria from SERVQUAL/RATER with the World Health Organization's requirements for healthcare infrastructure to create a comprehensive assessment framework we called the Rural Healthcare Assessment Model (RHAM), depicted in Figure 3.



*Figure 3. Rural Healthcare Assessment Model.*

We created RHAM to describe and assess whether the rural healthcare infrastructure has adequate facilities, is accessible, has adequate services, and is perceived as satisfactory by patients and professionals. Accessibility is assessed through the facility's geographical location and the distance between it and other facilities as well as villages, surrounding road conditions, means of entry, visibility, and ambulance routes. The facilities are assessed by looking at hours of operation, number and type of employees, diagnostic and treatment equipment, supply of emergency medicines, telecommunication equipment, level of sanitation, and safe water supply. Services are assessed by examining whether the health personnel have adequate training and professional certifications, whether preventative and rehabilitative services including educational and outreach programs exist, whether cost of services is feasible, and whether emergency and routine medical services available are sufficient. Finally, stakeholder perceptions refer to provider, patient, and user experiences.

These are assessed by examining their experiences and the challenges they note, satisfaction with the infrastructure, as well as gathering their feedback about the system and how they think it can be improved. This rubric enables analysis across a broad range of health services and capacity. We used RHAM to document and assess elements of healthcare infrastructure in Kamand as it allowed us to both quantify and measure quality of services when integrated into our data collection strategies.

## Methodology: Strategically Documenting and Assessing Regional Public Healthcare

To assess the quantity and quality of public healthcare infrastructure in a rural community, we followed the dimensions of RHAM, including location, facilities, services, and stakeholder perceptions. We established three objectives, outlined in Table 4.

*Table 4. Objectives and associated strategies.*

Objectives	Methods
Document the location, facilities, and services of the healthcare infrastructure in Kamand	<ul style="list-style-type: none"> <li>➤ Documentation sheet</li> <li>➤ Archival research from Zonal Hospital Mandi</li> <li>➤ Semi-standardized interviews with healthcare professionals</li> <li>➤ Observations</li> <li>➤ Photographs</li> </ul>
Obtain provider and user perceptions of regional healthcare service quality, including personal experiences, challenges, satisfaction, and suggestions	<ul style="list-style-type: none"> <li>➤ Semi-standardized interviews with healthcare professionals</li> <li>➤ Unstandardized interviews with IIT workers and residents of local villages</li> <li>➤ Survey IIT students and faculty</li> </ul>
Identify the bottlenecks and high pressure areas in service delivery based on information gathered from our previous objectives	<ul style="list-style-type: none"> <li>➤ Compare infrastructure observations with stakeholder responses to identify common themes in healthcare delivery</li> </ul>

Our first objective documented locations, facilities, and services offered by the Zonal Hospital Mandi, the Kataula CHC, and the seven SCs that serve the Kamand region. We designed a documentation sheet to record the location, facilities and services dimensions of the RHAM. To record the location of these health centres, we traveled to each facility using the IIT as a reference point to mark their positions by measuring distance using the odometer. We took note of road conditions, construction areas, and other obstacles that would impede access to the facilities. We also noted ambulance routes to identify the ease of getting to the medical facilities from various villages. We compiled this information on a map.

We documented the facilities through direct observation and photographs to record the hours of operation, the staff at the centre, equipment and supplies, sanitation, and the

telecommunication technology. This helped us understand the facilities' capacity for treatment. We also obtained information about the non-tangibles of service, including medical services, costs, governmental programs, and educational programs. We verified our findings against archival research from Zonal Hospital Mandi and the Ratti CHC.

Our second objective obtained stakeholder perceptions of the quality of the public healthcare system. We gathered data from sources in Hindi and translated their responses into English. We only disclosed the locations of the interviews to protect respondents' identities. We held semi-standardized interviews (Figure 4) with healthcare professionals to identify the system's successes and shortcomings. To garner input from typical users, we interviewed 20 IIT Mandi construction workers and residents of local villages. We held unstandardized interviews with these groups to encourage respondents to share personal



*Figure 4. Interview at an Ayurvedic centre in Neri.*

stories with the healthcare system. Finally, we sent a survey to 600 faculty and students of the IIT to collect information about experiences with the campus health facility and the local referral process. Using the information collected from these three sources, we identified the respondents' frustrations, commendations, and suggestions. Finally, we compared stakeholder responses with our own observations to identify bottlenecks and common high-pressure areas in service delivery.

## Healthcare Assessment Results

We present results of the RHAM assessment below, according to our objectives.

### *Location and Distance*

After traveling to each facility, we created a map, indicating the number of regional public health facilities, shown in Figure 5.

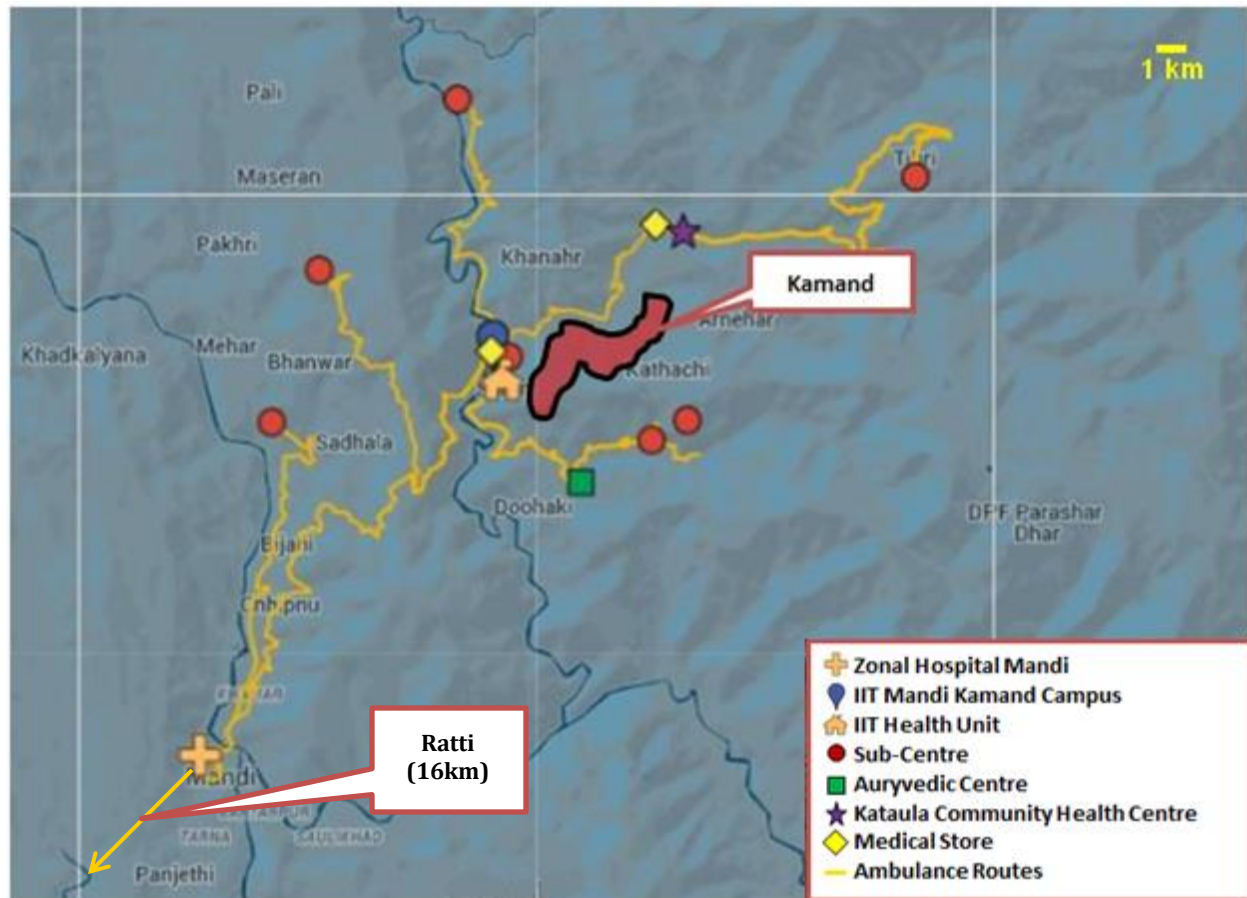


Figure 5. Healthcare infrastructure in the villages surrounding Kamand.

On April 1st, 2015, the Ratti Medical Block was split in two. This arrangement upgraded the Kataula Health Centre from a PHC to a CHC, creating the Kataula Medical Block that serves the Kamand region. We limited our map to show the regional facilities of the Kataula Medical Block.

Measuring distances between facilities and the Zonal Hospital Mandi, we found the range to be from 10 to 33 kilometers, which without obstruction, was between .5 and 1.5 hours of travel time. We took note of road conditions, construction areas, and other obstacles that would impede access to facilities. For example, the road to reach Neri/Navlay was under repair, creating an obstacle for vehicular travel. Two streams flowed over roads to the Riyagari and Tandu Sub-Centres. These are likely exacerbated during monsoon season, hindering transportation. The Balmand Sub-Centre and the village Dhukki are completely inaccessible by ambulance. Finally, all seven sub-centres were obscured behind trees, fences, and other buildings, reachable only by climbing dirt ramps and steep staircases (Figure 6).





Figure 6. The path to the Tihri sub-centre.

### Facilities and Treatment Capacity

We collected and classified facility information according to RHAM (Table 5).

Table 5. Regional facility characteristics.

Type or Name	Hours of Operation	Number of Employees	Positions	Number of Beds	Equipment	Medicinal Supply	Telecommunications	Sanitation	Water Filtration
Sub-Centres	9:30AM-4:00PM with lunch from 1:30PM-2:00PM	2	Health workers, asha workers	0	N/A	First aid and seasonal and common ailments	Mobile phones	N/A	No
Kataula CHC	9:00AM-4:00PM with lunch from 1:30PM-2:00PM	24	Medical officers, nurses, pharmacists, ophthalmologists, dentists, radiographer, maternal and family health workers, support staff	6	X-ray, laboratory, minor operation, injection	Emergency, first aid, and seasonal and common ailments	Landlines, mobile phones, fax machine	Yes	No
Zonal Hospital Mandi	24 hours	300	Same as above, Medical Officer of Health, Chief Medical Officer, physicians, surgeons, pathologist, microbiologist, gynecologists, dermatologists, ophthalmologists, clinical psychologist, radiologist	300	Same as above, CT, pathology equipment, major surgical equipment, ECG, ultra sound	Treatments for major ailments, anesthetics, emergency, first aid, and seasonal and common ailments	Landlines, mobile phones, computers, internet, fax machines	Yes	Yes

While Zonal Hospital Mandi has a wide array of medicines at its disposal, the supplies of the Kataula CHC and sub-centres is variable and currently dictated by the Block Medical Officer at Ratti. The supplies are delivered to the centres bi-annually and include 50 basic medications such as bandages, vaccines, prescriptions for seasonal ailments, and first aid necessities. With these supplies, doctors at the Kataula CHC were able to treat 60 patients per day, while sub-centres treated only around 10. However, Zonal Hospital Mandi saw patient numbers as high as 730 per day.

### **Costs and Services**

The Zonal Hospital Mandi contains the region's only specialists. Specialists have MD degrees earned after receiving their MMBS degree. Doctors at Kataula had MBBSs, obtained after six years of study and an internship period. Sub-centres were operated by staff with 18 months of medical training. Overall, those with more medical education are concentrated at the Zonal Hospital, not in rural areas. Regional staff works in conjunction with government programs (Table 6) that enhance healthcare delivery and target vulnerable groups.

*Table 6. Government programs in Himachal Pradesh.*

<b>Program</b>	<b>Description</b>
<b>JSSK (Janani Sishu Surkasha Karyakram) translates to Infant Protection Program</b>	Medicine is free for all children under 1 year of age
<b>JSY (Janani Surakaha Yojna) translates to Mother Protection Plan</b>	Women below poverty line are given free medicine throughout and up to 42 days after birth
<b>RBSK (Rashtriya Bal Swasthya Karyakram) translates to National School Health Program</b>	Students (K-12) are given free checkups at school
<b>Malaria Program</b>	Free testing and assistants at CHC
<b>Leprosy Program</b>	Free testing and assistants at CHC
<b>Polio Program</b>	Free testing
<b>Immunization</b>	Sub-centres offer vaccines every third Wednesday of each month
<b>Smartcard</b>	Card given to families that cover five people with free food in medicine if in-patient care and cover surgeries up to 1.75 lakhs

*The JSY and JSSK programs have been successful, particularly in Tandu where only 7 of 54 childbirths this year were performed in the home. Polio cases have dropped to zero and due to their widespread effectiveness; leprosy programs have not been necessary in years.*

Although diabetes is a widespread concern in India, the regional infrastructure did not offer any programs for diabetes prevention. This may be because the disease is less prevalent in Himachal Pradesh than in other Indian states, with only 568 cases reported in the entire Ratti Medical Block (population 175, 517) in 2014.

The Himachal Pradesh government sponsors programs for safe sex practices and family planning. There are also services for prenatal and postnatal care unique to



Figure 7. Himachal Pradesh maternal and child care ambulance.

the state. All prenatal care and ambulatory transportation for childbirth (Figure 7) are free of charge. If the ambulance is unavailable, the cost of travel to the Zonal Hospital is subsidized by the government. For postnatal care, doctors visit homes to monitor a newborn's health and administer free immunizations until the child is 1.5 years old.

Figure 8 indicates typical charges for services available at Zonal Hospital Mandi. Prices are standardized wherever they are offered. Overall, costs for common procedures are largely subsidized and fall within the range of ₹15 to ₹2200. Complex surgeries such as

ZONAL HOSPITAL, MANDI		
S.No.	Name of Test	Cost Charges
01.	Special Ward Room Rent (Per Day)	700.00
02.	TLC/DLC	25.00
03.	P.B.S.	30.00
04.	ESR	15.00
05.	R.H. Factor	40.00
06.	G.G.T.	40.00
07.	C.R.P.	40.00
08.	BT	15.00
09.	X-Ray (12x15)	60.00
	X-Ray (10x12)	40.00
	X-Ray (8x10)	30.00
10.	C.T.	15.00
11.	R.B.C. Count	15.00
12.	Plate Let Count	15.00
13.	Urine	15.00
14.	Throat Swab	15.00
15.	C.S.F.	80.00
16.	Ascitic Fluid	70.00
17.	Plural Fluid	70.00
18.	Blood Sugar	25.00
19.	Blood Urea	25.00
20.	Cholesterol	40.00
21.	Blood Grouping	30.00
22.	Bilirubin	20.00
Ambulance Charges (Per Km.) 10.00		
ULTRA SOUND		
01.	Ultrasound Charged	150.00
MEDICAL FOR LICENSES		
01.	Medical Fee	10.00
DENTAL CHARGES		
01.	Zink Oxide Filling	30.00
02.	Scaling	120.00
03.	Extraction	15.00
04.	Fracture	60.00
05.	Dislocation	50.00
06.	RCT with Root	100.00
07.	Silver Filling	70.00
08.	Light Cure Filling	70.00
09.	Minor Surgical Procedure	60.00
10.	Major Surgical Filling	120.00
11.	Denture Repair	75.00
12.	Full Denture below 65yrs.	2200.00
OPERATION CHARGES		
01.	Abortion	150.00
02.	Op. Abdominal Hysterectomy	400.00
03.	Op. Vaginal Hysterectomy	400.00
04.	Op. Prostatectomy	400.00
05.	Cholecystectomy	400.00
06.	Op. Laparotomy	300.00

Figure 8. Zonal Hospital Mandi service costs.

heart and neuro surgeries can cost upwards of ₹175,000. The cost of emergency services varies, depending on the patient's financial status. Zonal Hospital Mandi is the only facility in the region with emergency services. To prepare patients for travel to the Zonal Hospital, the Kataula CHC performs triage and can administer stitches, pain relief injections, and oxygen cylinders for patients reporting difficulty breathing. Sub-centres bandage patients before referring them to the Kataula CHC, and if necessary, the Zonal Hospital but do not provide routine medical services.

### Stakeholder Perceptions

Our interviews with healthcare professionals revealed that personnel at all seven sub-centres in the Kataula Medical Block (Kamand, Tihri, Taryambli, Neri/Navlay, Balmand, Tandu, and Riyagari) noted an inadequate supply of medicines. The supply of medicines at the sub-centres is not standardized. Workers make lists of and retrieve their needed supplies from Kataula. This unreliable supply is also exacerbated by a lack of

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*Workers at the Tihri and Tandu sub-centres stated that IFA tablets, a prenatal care supplement, had been unavailable for a year, while Vitamin A supplements had only recently become available for children.*

---

medical stores in the region. Other obstacles mentioned were a lack of staff and specialists, lay practitioners administering ineffective treatments, and unreliable public transportation. Despite these problems, personnel cited government health programs as successful.

Users typically cited transportation and cost as major obstacles to care. To avoid travel costs, they stated that they would seek traditional healers and herbal medicine or travel upwards of three hours on foot to the Kataula CHC. Our survey of IIT students and faculty, patients with greater than average income, were not referred to the public healthcare facilities in Kamand, but rather to private hospitals such as Mandav Hospital Mandi and K.S. Hospital Mandi. Respondents expressed concern for public healthcare facilities' ability to treat major illnesses and for their lack of ICU wards.

## Discussion

Our assessment identified a number of troubling trends, summarized below.

### Access to Supplies

Medications for common ailments are available in each CHC and PHC, but these facilities are typically resupplied only twice per year. Doctors stated that they would prefer being resupplied quarterly. They are required to have only basic medications, but Balmand, Tandu, and Tiri sub-centres noted that certain medications have not been delivered to them in over a year.

Operators of all seven sub-centres expressed a need for more frequent resupply of medications. There are several possible reasons for this problem. The roads near most sub-centres are in fairly poor condition. This in combination with the centres themselves being fairly inaccessible can make getting supplies there difficult. Often, sub-centre operators use private transportation to pick up supplies at a CHC, which is expensive and time consuming. Having supplies delivered directly to the sub-centres also incurs a great cost. Distributing and coordinating resources across the region costs more due to distances between health facilities.

### Access to Specialists

According to yearly statistics collected by the Zonal Hospital, each doctor at the Kataula CHC sees approximately 19 patients each day. The Kataula CHC currently has two working medical officers on staff, increasing patient volume per doctor to about 30 per day. The shortage of medical doctors we observed could be attributed to the fact that many doctors are not inclined to work in rural areas (Kumar, 2012). Doctors typically begin their careers in rural clinics but later move on to work in hospitals. Kumar's respondents noted that the circumstances of working in rural clinics are difficult, mentioning academic and social isolation (Kumar, 2012). Postings in underserved rural communities offer less in the realm of money and glamour than a position in an urban, private practice (Kumar, 2012). As skilled practitioners leave rural clinics, patients lose access to quality care. Finding



replacements can be difficult, leaving facilities short staffed for long periods of time. Our data indicated that patients needing specialists must travel some distance to the Zonal Hospital Mandi, or do without, and even that hospital could benefit from additional specialists, including cardiologists, neurologists, and gastroenterologists.

### Access to Facilities

One of the points brought up in village interviews was the challenge of facility accessibility. In emergency situations, an ambulance is contacted to transport the patient, ambulance routes are limited. In the instance of the Balmand Sub-Centre, residents reported tying patients to a chair in order to carry them down to an ambulance access

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*We spoke to a man in Dhukki that said that a private vehicle to get him to the Kataula CHC could cost ₹500; a vehicle to Mandi could cost ₹1000. This does not include the cost of additional medical services or medication upon arrival.*

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point. Interviews in Dhukki revealed a similar practice, using a mattress instead. This method is slow and risky.

Transportation to Zonal Hospital Mandi from Kataula CHC (21 km away), or from the sub-centres in Tihri, Taryambli, Neri/Navlay, Balmand, and Riyagari could take over an hour.

This estimate assumes good road conditions without obstacles; however, roads are prone to landslides, washouts, and construction, thereby adding travel time. Villagers and IIT laborers typically take more affordable public busses as an alternative, a cheaper but unreliable option since bus schedules can conflict with facility operating hours. Due to the

cost of travel, the Kataula CHC and Zonal Hospital Mandi are inaccessible to rural, remote populations and healthcare quality for these communities is compromised.

## Project Outcomes and Deliverables

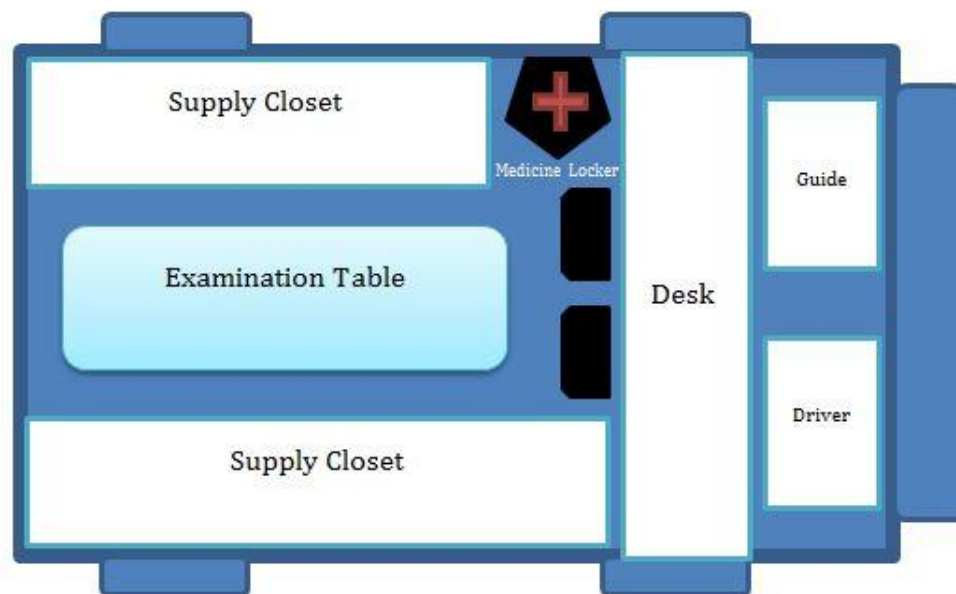
Three healthcare delivery bottlenecks emerged in our findings: access to supplies, specialists, and facilities. To address these, we formulated three recommendations, using a SWOT analysis to gauge feasibility.

1. Increase access to the medical resource network in the region by adding a Mobile Unit that can deliver both supplies and care to doctors and patients in remote villages and facilities.
2. Expand care available to patients in and around Kamand by increasing the number of specialists, especially cardiologists, gastroenterologists, neurologists, and psychologists.
3. Introduce affordable and simple equipment, such as lightweight stretchers discussed below, into villages with limited or no accessibility to main roads or ambulances.
4. Maintain regular evaluation with RHAM to track progress in the quality of the healthcare system.

### 1. Access: Mobile Unit

To increase access to healthcare in the Kataula Medical Block, we propose adding a Mobile Unit that would periodically visit towns and villages with poor access to sub-

centres. The unit could also deliver medications on a more regular basis. There are two ways to implement a mobile unit. The first is to add a branch of the National Rural Health Mission (NRHM) Mobile Medical Units to the Mandi District. MMUs have been implemented in Himachal Pradesh, but we found no evidence of this service in Mandi. The MMUs consist of one to three vehicles that contain trained medical personnel and medications. In instances where there are multiple vehicles, one might carry basic laboratory facilities and one might carry more advanced diagnostic equipment (MMUs, 2012). Thus, as an expensive (roughly 18-23 lakhs) district-wide investment, a fully equipped unit would not be able to focus exclusively on the Kataula Medical Block, meaning that it would be unable to make regular stops at sub-centres to deliver supplies. Regular maintenance also costs up to 23.71 lakhs per year. Another option is to create, a single vehicle with fewer capabilities, having a staff of only three, an MO, a nurse, and a driver. This unit could be based at the CHC Kataula and travel to each of the sub-centres in the block on a rotating four week cycle, with two days spent at two different sub-centres and one day spent on call each week. The centre would be outfitted with an examination bed, supply closets, and medicine lockers (Figure 9). The Mobile Unit would be stocked with first aid equipment, including the 50 basic medications required by each sub-centre and any other supplies deemed necessary by the operator. Having a doctor visit sub-centres regularly will increase the quality of care and will allow medicinal supplies to be delivered more often.



*Figure 9. Scaled-down mobile unit*

## **2. Care: Rural Doctor Scholarship Program**

To replenish the current system, we recommend that professionals and specialists, including gynecologists, pediatricians, and MBBS graduates, are distributed throughout the region to rural health facilities. This will relieve some of the pressure that doctors currently face, providing more staff to treat patients. However, there are current issues in training

specialists and getting them to work in rural areas. We recommend a partnership with the new ESIC medical school in Ner Chowk in Mandi. This partnership will have medical students interning at local PHCs, CHCs, and sub-centres. As part of the MBBS education, students are required to perform a one year rotation internship. In addition, the government might, through a Rural Doctor Scholarship Program, offer scholarships or subsidize the students' education if they commit to work at regional facilities after graduating. Funding could be drawn, in part, from existing funds for currently unfilled but sanctioned positions at rural clinics. Furthermore, this program could be expanded to subsidize MBBS doctors' educations for a specialty degree in gynecology or pediatrics (sanctioned positions in CHCs and PHCs for those who agree to work at the clinic for some subsequent period). Ultimately, this could alleviate the regional staffing problem, encourage students to pursue more training, and bring specialized treatment to rural populations.

### **3. Technology: Safe Transportation Stretchers**

Our final recommendation is to provide stretchers to all villages and sub-centres in the Kataula Medical Block. Several facilities we visited had poor accessibility to roads and ambulance routes. Stretchers could ensure safer transport of patients in these situations. The stretcher design should be durable, inexpensive, lightweight, and have immobilization capabilities. The design should maintain a patient's position even during transport on the region's steep inclines. Supplying every village and sub-centre with this equipment will increase patient safety while they are moved to ambulance access points or the nearest care facility.

### **4. Evaluation: RHAM for Repeat Assessment Follow Up**

One result of our project was the creation of the Rural Healthcare Assessment Model. This model allowed us to assess healthcare infrastructure in the Kamand region, revealing bottlenecks in service delivery. The RHAM could be used periodically to identify system improvements. RHAM, with its four categories of location, facilities, services, and stakeholder perceptions, could also be used to assess the healthcare infrastructure in any rural community, but the sub-criteria in each quadrant could be changed according to community needs or constraints. Our goal was to identify bottlenecks in service delivery; however, at a later date a team could use RHAM to search for mismanagement or standardized practices, among other possibilities.

### **Additional Observations**

Although our stakeholders did not note this, there is no management information system in place in the Kataula Medical Block. Without a database to record patient information, epidemiological statistics, inventories, shipments, and deliveries, it is not surprising that there are often shortages in needed supplies, and that disease statistics are often misreported. To increase the existing system's efficiency, to improve information sharing and referrals across facilities, and to give professionals access to expert resources on diagnostics and treatment plans, a management information system could be implemented. To implement such a database, however, computers and internet connections would need to be provided to all sub-centres in the medical block.

## Conclusion

The results of our collaboration with regional stakeholders revealed three existing bottlenecks in the healthcare system: inadequate access to supplies, specialists, and facilities. More importantly, we learned that the assessment of rural healthcare requires emphasis on factors that go beyond the sheer number of facilities. Site-specific obstacles including road conditions, cost of public transportation, and access to specialists greatly undermine the capacity of local facilities to provide needed services. The RHAM determined healthcare vulnerabilities in rural communities, and we subsequently identified short and long-term recommendations to overcome these obstacles.

While our project focused on infrastructure of the public healthcare system, future research could further investigate the management of these facilities and could expand to private sector healthcare as well. Moreover, future efforts will be needed to develop, test, and implement a Mobile Unit or a Rural Doctor Scholarship Program as suggested. While the existing public healthcare infrastructure has many strengths, including extensive government programming and treatment subsidies, improvements can be made through informed technological, social, and administrative solutions.



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# Supplemental Materials: Methodology

## Clinic Documentation Sheet

Health Centre Documentation Sheet			
Name		Date	
Image		Map	
Location			
Block:			
Village Name:			
Distance to Zonal Hospital:			
Hours of Operation			
Employee Information			
Educational Programs			

<b>Equipment</b>		
<b>Medicinal Supply</b>		
<b>Communication Technology</b>		
<b>Services and Costs</b>		
<b>Sanitation</b>		
	<b>Y</b>	<b>N</b>
Is there equipment to sterilize tools?		
Does the facility appear to be sanitary (i.e. washrooms, surfaces, floors)?		

Additional Observations



## Health Center Questionnaire Guide

How many sub-centres in the region are served by this centre?

How often are you at the health centre / what are the operating hours of the health centres and the sub-centres you serve?

Presently, what diseases are majorly afflicting the region?

What emergency services are available?

What other basic treatments do you offer?

How do you sanitize your equipment and other supplies?

What advanced diagnosis techniques are available (ie. Technical Equipments/ XRay/ Pathology etc)?

Do you have staff specifically trained in using these devices?

How often are there patients who need services that you don't offer, and what do you do in this situation?

What are the greatest obstacles you face in giving care to patients?

How many patients do you treat a week?

How many beds are available for patients?

What supplies do you lack?

How often are you resupplied with medicines and other supplies?

How quickly can you make a medicine available that you don't normally stock?

How many people work at this health centre and its corresponding sub-centres? May we have a list of names and positions?

What are the standards of qualification for those in your position? Do most of your colleagues meet that?

What is the best mode of transportation to the clinic or hospital? How do most patients arrive?

Are government ambulances able to reach this centre? How often do patients use this service?

What educational programs do you offer? How many patients take advantage of these? Are there any others that you would like to add?

How often and by what method do you communicate with other health specialists?

What kind of government involvement is there in the healthcare system in Himachal Pradesh? What authority oversees this centre?

What are the government prescribed norms for a sub-centre?

Do you have a documented inventory of your supplies? If so may we see a copy? If not, may we take an inventory?

## IIT Mandi Healthcare Questionnaire

In fulfillment of an ISTP project, the following questions will be used to assess the service quality of healthcare infrastructure in and around the Kamand region. This survey is to be answered voluntarily, and all responses will be kept confidential.

What is your age?

Please specify your gender:

- Male
- Female

Since attending IIT Mandi, have you received any medical treatment or diagnosis from the IIT health unit? If you are willing, please describe your most recent ailment how you were treated for it.

Has the IIT Health Unit ever referred you to a different health facility for an ailment? If yes, where?

If you have been referred elsewhere, how did you get there? Did you have any problems getting to this facility? If so, what was the cause?

If you are willing, please describe your most recent ailment that required referral and how you were treated for it.

Has there been an instance in which you feel that you did not receive the best treatment possible at the IIT or at a healthcare facility in the Mandi district? If so, can you explain?

From your past experiences, have you noticed any issues with the healthcare in and around Kamand? In the Mandi district? Do you have any suggestions on how to improve the performance?

Do you have any other personal stories or experiences with the healthcare system in the Mandi district that you would be willing to share with us?

When you visited the IIT Mandi healthcare center, were the doctor/nursing staff present to attend to you immediately, or did you have to wait for them? If the latter, please specify the time for which you waited.

# Semi-standardized Interview Questions for Patients

The following questions will be used to assess the service quality of healthcare infrastructure in the region. All responses will be kept confidential.

**Age:**

**Gender:**

Which health centres or hospitals have you visited in the past year? past five years?

If you have not visited any health centres or hospital, from where do you receive treatment?

**Reliability:**

1. On average, how long does it take for you to get to the health centre or hospital?
2. How do you get to the nearest health centre or hospital?
3. Do you regularly have trouble getting to the health centres? If so, what is the cause?
4. Was there an instance where you feel that you did not receive the best treatment possible? If so, can you explain?
5. Do you feel that you receive care in a timely manner? About how long does it take for you to receive care?

**Assurance:**

6. Do caregivers typically explain what they were doing in a way that you understood?
7. Do caregivers answer your questions in a manner in which you understood?
8. Has there ever been an instance where the caregiver was unable to treat you? If so, what did they do?
9. Have you been prescribed different treatments for the same ailment from different caregivers at different health centres? The same health centres?

**Tangibles:**

10. Have you ever visited a health centre and been denied a bed because the facility was full?
11. Did the health centre have a pharmacy to give you needed medication? If not, how did you purchase your prescription? Was it difficult to do so?
12. During your previous visits, did your caregiver need to use medical equipment that was unavailable or being repaired? If so, how did the caregiver refer you to a different health centre or hospital?
13. Have you visited a health centre where you had to come back for treatment because the doctors were unavailable or not present?

14. Does the health centre or hospital keep a record of your past ailments? If not, do you have this record in your possession?

**Empathy:**

15. When you visit a health centre or hospital, do you typically receive individualized attention?

16. Were you able to pay for your prescribed treatment? If not, did the government, hospital, or health centre help you pay for it?

17. Do caregivers properly explain what measures should be taken at home for your prescriptions?

**Responsiveness:**

18. Have you ever been referred to another health centre or hospital because your nearest health centre does not have the medical services you require?

19. Has your treatment ever been delayed due to an incident at the hospital or health centre?

20. Have you ever been turned away from a caregiver because they were unable to treat you?

What major issues do you see with the healthcare in Mandi?

Do you have any personal stories or experiences with the healthcare system in Mandi that you would be willing to share with us?

# Supplemental Materials: Results and Discussion

## SWOT Analyses for Recommendations

### *Mobile Unit*

<b>Strengths</b>	<ul style="list-style-type: none"> <li>• Mobile medicine has had high success in other rural locations</li> <li>• Increases accessibility of care to people far away and reduces costs of travel</li> <li>• Can deliver medications from Mandi Zonal or CHC Kataula on its rounds</li> <li>• Increases medical staff in the area</li> </ul>
<b>Weaknesses</b>	<ul style="list-style-type: none"> <li>• Additional staff will need to be trained</li> <li>• Will need a vehicle capable of traveling off road</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Large patient base</li> <li>• Reduced costs for patients to obtain care</li> </ul>
<b>Threats</b>	<ul style="list-style-type: none"> <li>• Road condition in monsoon season</li> <li>• Create dependence upon mobile centre</li> </ul>

### *Rural Doctor Scholarship Program*

<b>Strengths</b>	<ul style="list-style-type: none"> <li>• More accurate diagnosis</li> <li>• Less pressure on present staff</li> <li>• Provides better quality healthcare to rural areas</li> <li>• Medical students get firsthand experience and discounted education</li> </ul>
<b>Weaknesses</b>	<ul style="list-style-type: none"> <li>• There is a shortage of specialists at Zonal Hospital Mandi</li> <li>• Medical school is just opening, and will need several years before first interns come in</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Funding from previously subsidized positions</li> <li>• Newly established medical school will provide a constant supply of new specialists</li> </ul>
<b>Threats</b>	<ul style="list-style-type: none"> <li>• Specialists refuse to work in rural areas</li> <li>• Medical school does not wish to partner with CHC Kataula</li> </ul>

### *Safe Transportation Stretchers*

<b>Strengths</b>	<ul style="list-style-type: none"> <li>• Safe transportation to healthcare facilities and ambulance lines</li> <li>• Increase accessibility for injured patients</li> </ul>
<b>Weaknesses</b>	<ul style="list-style-type: none"> <li>• Possible expenses involved in production</li> <li>• Large size</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Improved safety in transportation</li> <li>• Sub-centres are currently not supplied with stretchers</li> </ul>
<b>Threats</b>	<ul style="list-style-type: none"> <li>• Maintenance</li> <li>• Availability of materials</li> <li>• Rough terrain</li> </ul>